

**What Is Claimed Is:**

1           1.    A method for I/Q mismatch calibration of a receiver  
2    having    an    I/Q    correction    module    which    performs  
3     $x_o[n] = A_p \cdot x_i[n] + B_p \cdot x_i^*[n]$     where     $x_i[n]$     and     $x_o[n]$     respectively  
4    represent the input and output signal of the I/Q correction  
5    module, the superscript \* refers to a complex conjugate, and  $A_p$   
6    and  $B_p$  are correction parameters, comprising the following  
7    steps:

8           generating a test signal  $x(t)$  containing a single tone  
9                    waveform with frequency of  $(f_c + f_T)$  Hz , where  $f_c$  and  
10                   $f_T$  are real numbers;  
11          applying I/Q demodulation to reduce the central frequency  
12                  of the test signal  $x(t)$  by  $f_c$  Hz and output a  
13                  demodulated signal  $x_{dem}(t)$  ;  
14          converting the demodulated signal  $x_{dem}(t)$  to a digital  
15                  signal  $x_{dem}[n]$  ;  
16          obtaining measures  $U_1$  and  $U_2$  of the digital signal  $x_{dem}[n]$   
17                  where  $U_1$  and  $U_2$  are values indicative of the frequency  
18                  response of  $x_{dem}(t)$  at frequency  $+f_T$  Hz and  $-f_T$  Hz ,  
19                  respectively; and  
20          calculating the set of the correction parameters  $A_p$  and  $B_p$   
21                  for the I/Q correction module based on the measures  
22                   $U_1$  and  $U_2$ .

1           2.    The method for I/Q mismatch calibration of a receiver  
2    as claimed in claim 1, the measure  $U_1$  and  $U_2$  are obtained from  
3    the coefficients of the Fourier transformation of the  $x_{dem}[n]$   
4    corresponding to the frequency  $+f_T$  Hz and  $-f_T$  Hz.

1           3.    The method for I/Q mismatch calibration of a receiver  
2   as claimed in claim 1, wherein the test signal  
3    $x(t)=\cos(2\pi(f_c+f_T))$ .

1           4.    The method for I/Q mismatch calibration of a receiver  
2   as claimed in claim 1, wherein the set of correction parameters  
3    $(A_p, B_p)$  are obtained by

$$\begin{cases} A_p = R + j\alpha S \\ B_p = -\alpha R - jS \end{cases}$$

5           where  $\alpha$ ,  $R$ , and  $S$  are obtained based on  $U_1$  and  $U_2$ .

1           5.    The method for I/Q mismatch calibration of a receiver  
2   as claimed in claim 4, wherein  $\alpha$ ,  $R$ , and  $S$  are obtained based  
3   on

$$H = \text{real}(U_1 \cdot U_2) ,$$

$$I = \text{imag}(U_1 \cdot U_2) ,$$

6           and

$$G = |U_1|^2 + |U_2|^2 .$$

1           6.    The method for I/Q mismatch calibration of a receiver  
2   as claimed in claim 4.1, wherein  $\alpha$ ,  $R$ , and  $S$  are obtained by

$$\alpha = \frac{H}{\kappa} ,$$

4           where

$$\kappa = \frac{G + \sqrt{G^2 - 4H^2}}{2} ,$$

6           and

$$R = \sqrt{\frac{1+P}{2}},$$

$$S = \sqrt{\frac{Q}{2 \cdot \sqrt{\frac{1+P}{2}}}},$$

where

$$Q = \frac{2 \cdot I}{\kappa \cdot (1 - \alpha^2)},$$

$$P = \sqrt{1 - \left( \frac{2 \cdot I}{\kappa \cdot (1 - \alpha^2)} \right)^2}.$$

7. The method for I/Q mismatch calibration of a receiver as claimed in claim 4, wherein the set of correction parameters  $(A_p, B_p)$  is further normalized such that the power of the output signal of the I/Q correction module equals to that of the input signal of the I/Q correction module.

8. An apparatus for I/Q mismatch calibration of a receiver having an I/Q correction module which performs  $x_o[n] = A_p \cdot x_i[n] + B_p \cdot x_i^*[n]$  where  $x_i[n]$  and  $x_o[n]$  respectively represent the input and output signal of the I/Q correction module, the superscript \* refers to a complex conjugate, and  $A_p$  and  $B_p$  are correction parameters, comprising:

a signal generator for generating a test signal  $x(t)$  which contains a single tone waveform with frequency of  $(f_c + f_T)$  Hz, where  $f_c$  and  $f_T$  are real numbers;

a demodulator for applying I/Q demodulation to reduce the central frequency of the test signal  $x(t)$  by  $f_c$  Hz and outputting a demodulated signal  $x_{dem}(t)$ ;

13 A/D converters for converting the demodulated signal  $x_{dem}(t)$   
14 to a digital signal  $x_{dem}[n]$ ;  
15 a dual-tone correlator for obtaining measures  $U_1$  and  $U_2$  of  
16 the digital signal  $x_{dem}[n]$  output from the I/Q  
17 correction module where  $U_1$  and  $U_2$  are values  
18 indicative of the frequency response of  $x_{dem}(t)$  at  
19 frequency  $+f_T$  Hz and  $-f_T$  Hz, respectively; and  
20 a processor for obtaining the set of the correction  
21 parameters  $A_p$  and  $B_p$  according to the measures  $U_1$  and  
22  $U_2$ .

1 9. The apparatus for I/Q mismatch calibration of a  
2 receiver as claimed in claim 8, the measure  $U_1$  and  $U_2$  are obtained  
3 from the coefficients of the Fourier transformation of the  
4  $x_{dem}[n]$  corresponding to the frequency  $+f_T$  Hz and  $-f_T$  Hz.

1 10. The apparatus for I/Q mismatch calibration of a  
2 receiver as claimed in claim 8, wherein the test signal  
3  $x(t) = \cos(2\pi(f_c + f_T)t)$ .

1 11. The apparatus for I/Q mismatch calibration of a  
2 receiver as claimed in claim 8, wherein the set of correction  
3 parameters  $(A_p, B_p)$  are obtained by

$$4 \quad \begin{cases} A_p = R + j\alpha S \\ B_p = -\alpha R - jS \end{cases}$$

5 where  $\alpha$ ,  $R$ , and  $S$  are obtained based on  $U_1$  and  $U_2$ .

1 12. The apparatus for I/Q mismatch calibration of a  
2 receiver as claimed in claim 11, wherein  $\alpha$ ,  $R$ , and  $S$  are obtained  
3 based on

$$4 \quad H = \text{real}(U_1 \cdot U_2^*),$$

5 
$$I = \text{imag}(U_1 \cdot U_2) ,$$

6 and

7 
$$G = |U_1|^2 + |U_2|^2 .$$

1 13. The apparatus for I/Q mismatch calibration of a  
2 receiver as claimed in claim 12, wherein  $\alpha$ ,  $R$ , and  $S$  are obtained  
3 by

4 
$$\alpha = \frac{H}{\kappa} ,$$

5 where

6 
$$\kappa = \frac{G + \sqrt{G^2 - 4H^2}}{2} ,$$

7 and

8 
$$R = \sqrt{\frac{1+P}{2}} ,$$

9 
$$S = \sqrt{\frac{Q}{2 \cdot \sqrt{\frac{1+P}{2}}}} ,$$

10 where

11 
$$Q = \frac{2 \cdot I}{\kappa \cdot (1 - \alpha^2)} ,$$

12 
$$P = \sqrt{1 - \left( \frac{2 \cdot I}{\kappa \cdot (1 - \alpha^2)} \right)^2} .$$

1 14. The apparatus for I/Q mismatch calibration of a  
2 receiver as claimed in claim 11, wherein the set of correction  
3 parameters  $(A_p, B_p)$  is further normalized such that the power of  
4 the output signal of the I/Q correction module equals to that  
5 of the input signal of the I/Q correction module.